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DEFORMED DIATOMS.

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The general uniformity in the recognized species of Diatoms and their adherence to beautiful geometric forms are so marked that we are apt to overlook the fact that irregularities and deformities are not rare. Notes of a few of these have been published, but I believe it may be instructive for students and observers to keep a record of the abnormal variations from type. Such notes will enable us to make some broader comparisons of the character and extent of these "sports," and possibly to draw some sound conclusions as to the causes of variation and its bearing upon the distinction of species.

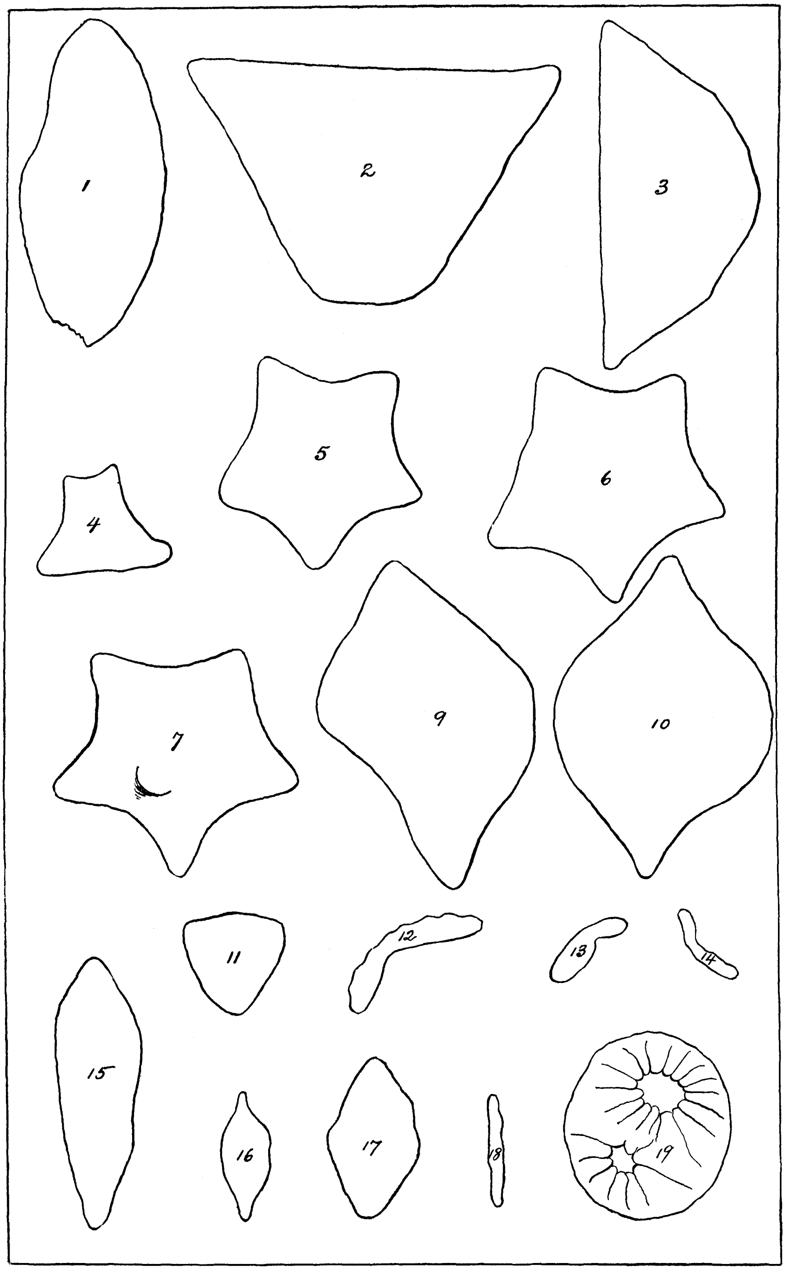
The following memoranda refer to examples which I have met from time to time in my own investigations, and which I have photographed. Prints of these are deposited with the curator for the use of the Society. I have provisionally arranged them in three classes: 1. Those having indented or deformed outlines; 2. Those having a double or multiple center in the scheme of marking; 3. Those having the marking unsymmetrically varied. The prints have amplification × 700.

I. INDENTED OR DEFORMED OUTLINES.

1. *Navicula lyra, Ehr.* Santa Monica, Cal.; fossil. One side boldly indented in a large, easy curve.

2. *Triceratium favus, Ehr.* Maranham Island, Pacific Ocean; recent. One angle is wanting, two sides being joined by a curve, making one diameter one-fourth less than the others. The process is present at the deformed angles, but is unsymmetrically placed.

3. *Same species*, from same gathering. A similar deformity carried further. The form almost semi-lunar, but the curve is not regular. The third process is wanting.



This plate is traced from photographs and reduced one-half, and the numbers of the figures correspond with the numbers of the paragraphs, all but No. 19 being in the first class.

4. *Triceratium robustum, Grev.= T. sculptum Shadbolt?* Calvert Co., Maryland; fossil. One of the angles is replaced by two smaller ones, giving an irregular trapezoidal form to the shell.

5. *Triceratium formosum, Brightwell, var. pentagonalis, Grun.* Samoa Islands, Pacific Ocean; recent. One of the indentations between the points of the star is nearly obliterated, and the two points connected by an irregular curve.

6. *Same species and variety*, from same gathering, similar deformity, but the line connecting two points of the star is more nearly straight, showing a tendency to revert to the triangular form of the type.

7. *Same species and variety*, from same gathering. The deformity here consists of a large umbonate protuberance in the center of the shell, its surface covered by the regular marking.

8. *Same species, typical.* San Luis Obispo, Cal.; fossil. A typical triangular form, but with the central protuberance noted in No. 7.

9. *Biddulphia rhombus, W. Smith.* Cuxhaven, North Sea; recent. One side deformed by a large, irregular indentation.

10. *Same species*, same gathering. Similar deformity but less pronounced.

11. *Same species.* Triangular form = *Triceratium striolatum, Ehr.* A group of three specimens, of which two are the triangular forms, with regular and moderately convex sides; the other specimen has one such side, but the other two curving into each other in a similar way to No. 2 above. The third process is wanting, but in its place are two spines, such as appear on the sides of the regular *Biddulphia* form. Variation in this species is so common that it would be easy to make a series of photographs showing the gradual passage of the *Biddulphia* into the triangular form.

12. *Eunotia diadema, Ehr.* Charleston, S. C.; recent. The concave side irregularly curved, making the width of the shell much less in one place than elsewhere. The convex side is regularly eight-toothed.

13. *Eunotia monodon, Ehr.* Loka deposit, Sweden; fossil. A deep irregular indentation on concave side near one end, making the shell roughly comma-shaped.

14. *Eunotia arcus, Ehr.* Dolgelly earth, Ireland; fossil. A similar (but less marked) irregularity. In a recent gathering at Cincinnati, Ohio, these *Eunotias* are found with so irregular reversed curves as to resemble wriggling earth-worms in outline. A specific distinction has been improperly based on this peculiarity.

15. *Licmophora ovata, Ehr.* Santa Monica, Cal.; fossil. A large, shallow indentation on one side, giving a gracefully varied outline.

16. *Rhaphoncis amphiceros, Ehr.* Savannah, Ga.; recent. One side of the shell a regular curve, the other very irregular.

17. *Cymatopleura elliptica, Bréb.* France; recent. The outline of the shell on one side irregularly wavy.

18. *Grammatophora marina, Kg.* Algoa Bay, Africa; recent. One side wavy, unsymmetrical.

II. DOUBLE OR MULTIPLE CENTER IN THE SCHEME OF MARKING.

19. *Mastogonia actinoptychus, Ehr.* Richmond, Va.; fossil. Elliptical form, with two distinct central spaces from which the costae radiate.

20. *Stictodiscus californicus, Grev.* San Luis Obispo, Cal.; fossil. A fine circular specimen with two centers, the radiating costae approximately regular on the outer limbs, but anastomosing in the space between the two centers.

21. *Navicula samoënsis, Grun.* (=*Nav. palpebralis, Greg. ?*) Samoa Islands, Pacific Ocean; recent. In one half of the shell, longitudinally, a second median nodule appears, with striæ radiating from it in all directions.

22. *Biddulphia balæna, Ehr.* = *Triceratium formosum, Brightwell.* Spitzbergen, Arctic Sea; recent. A large *Biddulphia* form, in which the delicate marking radiates from four or more distinct points as centers.

III. MARKING UNSYMMETRICALLY VARIED.

23. *Coscinodiscus robustus, Grev.* Pabellon de Pica, S. A.; guano. The areolation is so irregular as to have lost all hexagonal form. Its strong margin, robust habit, and its occurrence among typical specimens of similar size, &c., fix the specific relation. A similar example in same species was found in the Santa Monica deposit.

24. *Arachnoidiscus ehrenbergii, Bailey.* Santa Monica, Cal.; fossil. The radiating costæ irregularly wavy and anastomosing near the center, where they also become fainter and hardly traceable.

25. *Actinoptychus heliopelta, Grun.* Nottingham, Maryland; fossil. A specimen with five elevated rays. These are plainly distinguished at the central zone, but the undulations flatten out soon,

and the outer part of the shell is quite flat and evenly areolated. The rim with its irregularly scattered spines is typical.

26. *Triceratium affine, Grun.* Samoa Islands, Pacific Ocean; recent. The areolation is so irregular as to lose entirely its hexagonal character; this is the case all over the shell. Its size and outline and its occurrence among numerous typical specimens show its relations. A second example has been noted on another slide from same locality.

27. *Amphitetras antediluviana, Ehr.* Kiel, Baltic Sea; recent. The central part of the shell is irregularly areolate with a tendency to two centers. The typical forms common in same gathering have the central areolation evenly concentric.

28. *Navicula elliptica, Kg.* Crane Pond, Mass.; recent. The striation is irregularly wavy, especially at the ends.

29. *Epithemia turgida, Kg.* Berlin, Germany; fossil. The costæ and areolation are so irregular as to destroy all pattern in one-half the shell and nearly so in the other.

30. *Nitzschia scalaris, Ehr.* Sodertelge, Sweden; recent. In one part of the shell the keel is distorted, and instead of it appear two nodules on the face of the shell with irregularly radiating striæ.

Whenever I speak of striation I mean to be understood that it is resolvable into dots similar in character to those of the typical forms of same species.

In the examples which I have placed in classes II and III above, we see the distortion occurring by the miscarriage or interruption of the vital force which tends to produce the symmetrical sculpture of the shell of the diatom. In class I the cause of the irregularity would seem to be external and mechanical. It results, apparently, from the conditions of growth within a strong silicious box. When fission occurs the envelope of the new cells is at first flexible and is often found very slightly silicified, but it acquires rigidity as the deposition of silex goes on.* Under these conditions, if we suppose that the diatom is better supplied with nutriment than common and its circumstances are such as to make more vigorous growth, the valves of the new cell may tend to grow larger than the parent in all directions, and being confined by the strongly silicified coat of the mother cell, its own more flexible wall may fold upon itself and make a wavy irregularity of outline, such as is shown in some of the examples above noted.

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* See Study of *Isthmia nervosa* by the author, in Am. Journal of Microscopy, vol. iii, p. 97 (1878).

The examples of irregular wavy outline suggest also the conclusion that if, in the circumstances last supposed, the diatom were one whose shell presented alternate strong and weak points in its circumference, the indentations resulting would also be regular and we should have a crenulate form of a shell normally smooth in outline. My own observations have led me to think it probable that crenulated forms are thus originated. Once produced, further fissiparous division would tend to perpetuate the peculiarity, since the growing force in the new cells would force the flexible walls outward to fill the matrix.

It would not be till the process of conjugation is reached that the resumption of the normal type could reasonably be expected; consequently it would be premature to conclude that the crenulation is a specific distinction or even the mark of a lasting variety until it is proven that after conjugation the new series of diatoms retains that form.

Considerations of this sort may assist us in reducing the enormous catalogue of species in the *Diatomaceæ*, a "consummation devoutly to be wished."